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New York State Department of Environmental Conservation

Division of Environmental Remediation

Franklin Cleaners Site

Groundwater Extraction and Treatment System

Site No. 1-30-050

Remedial System Optimization Report

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REMEDIAL SYSTEM OPTIMIZATION REPORT

FRANKLIN CLEANERS SITE
ROCKVILLE CENTRE, NEW YORK

SITE NO. 1-30-050

Prepared for:

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION

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1.0 INTRODUCTION

This Remedial System Optimization (RSO) Report has been prepared in an effort to evaluate the current remedial status of the Franklin Cleaners Site, as well as audit the performance of the Site remedy in order to improve its efficiency, effectiveness and net environmental benefit. A current active remedy, a groundwater extraction and treatment system (GWE&TS), is located at 1000 Hempstead Avenue in the Village of Rockville Centre, New York, approximately 1 mile downgradient of the former Franklin Cleaners Site (the Site) located at 206-208B South Franklin Street in the Incorporated Village of Hempstead, New York. A Site location map is provided as *Figure 1-1*. The Site is a NYSDEC Class 2 Inactive Hazardous Waste Site and is listed on the New York State Registry of Inactive Hazardous Waste Sites (Site No. 1-30-050).

The GWE&TS has been operating since September 2004 and is designed to intercept the leading edge of a chlorinated-solvent groundwater plume originating from the Site. The RSO evaluation focuses on identifying potential system modifications/alternatives for reducing overall project costs and expediting Site closure.

In addition to the installation of the GWE&TS at the leading edge of the plume, "source area" contamination at the former location of the dry cleaning establishment was remediated via a soil vapor extraction and air sparging (SVE/AS) system, which operated from November 2003 to August 2004. The SVE/AS system was shut down in August 2004 based on contaminant concentrations detected below NYSDEC guidelines. Further details regarding the "source area" remediation are provided in the draft Final Remediation Report for the Franklin Cleaners On-site SVE/AS, dated June 2009.

A Site Inspection and Background Search was completed as the first element of this RSO. The Site Inspection was completed on October 18 & 19, 2011. Results from the Site Inspection and Background Search are summarized in a Letter-Report, dated December 6, 2011, which is provided as *Attachment A*.

Note, although this RSO evaluation focuses on the GWE&TS, pertinent events associated with the Site "source area" are summarized and discussed in the following report sections, as appropriate.

2.0 REMEDIAL ACTION DESCRIPTION

2.1 Site Description

The narrative presented in Section 1.0 Introduction provides a brief description of the Site location. The Site hydrogeologic setting and remedial history, including the nature and extent of contamination and a review of the overall Site conceptual model and potential receptors is presented below.

2.1.1 Hydrogeologic Setting

In general, the geology underlying the Site consists of a southeastward thickening wedge of unconsolidated deposits overlying crystalline bedrock.

The following general summary of the unconsolidated deposits in the vicinity of the Site is derived from Smolensky, et al., 1989. The Lloyd Sand Member of the Raritan Formation directly overlying the bedrock beneath the Site is Late Cretaceous age, and is approximately 300 feet thick underlying the Site. The Lloyd Sand Member is comprised primarily of sand and gravel with some clay lenses. The Raritan Clay directly overlies the Lloyd Sand Member, with a thickness of approximately 100 feet. The Magothy aquifer overlies the Raritan Formation with a thickness of approximately 500 feet. The Magothy aquifer generally consists of alternating layers of fine sand, silt and clay, with the silt and clay layers typically associated with the uppermost portion of the aquifer. The shallowest unconsolidated deposit is the Pleistocene-aged Upper Glacial aquifer, which overlies the Magothy aquifer and generally consists of very fine to coarse sand and gravel.

The saturated sands and gravels of the Lloyd, Magothy and lower portion of the Upper Glacial deposits form Long Island's three major aquifers. These aquifers constitute Long Island's Sole Source Aquifer, as designated by the Environmental

Protection Agency (EPA) and pursuant to Section 1424(e) of the Safe Drinking Water Act. A Sole Source Aquifer is defined as one which supplies at least 50% of the drinking water consumed in the area overlying the aquifer, which would have no reasonably available alternative sources of drinking water should the Sole Source Aquifer become contaminated.

Based on a review of Smolensky, et al., 1989, the Upper Glacial aquifer is the uppermost water-bearing unit at the Site. According to the NYSDEC, fresh groundwater at the Site would be classified as GA (New York State Codes, Rules and Regulations, Title 6, Chapter X, Parts 700-705, effective March 1998). The best usage of GA water is as a source of potable water supply.

The Upper Glacial aquifer is approximately 80 feet thick beneath the Site and consists mostly of glacial outwash which is generally fine to coarse sand and gravel with thin local lenses of clay. Hydraulic conductivity values average approximately 250 ft/day. However, this does not imply that groundwater contaminants will travel at this rate.

The Magothy aquifer ranges from 300 to 600 feet thick. The unit consists mostly of fine to medium sand and clayey sand interbedded with lenses and layers of coarse sand, and sandy to solid clay. Gravel is common in the basal zone and discontinuous layers of gray lignitic clay are common in the upper zone. Hydraulic conductivities average 50 and 60 ft/day and may range as high as 190 ft/day in the basal zone. Groundwater flow is predominantly south-southwest.

As measured during the most recently reported groundwater sampling event (Site Management Quarterly Report No. 27), groundwater beneath the Site is located at approximately 18 feet below grade. Shallow groundwater generally flows to the south or southwest toward Hempstead Lake and several creeks, which ultimately discharge to the various bays along Nassau County's southern shore.

2.1.2 Nature and Extent of Contamination

In March 1990, the Nassau County Department of Health (NCDOH) investigated a complaint of tainted drinking water from a private residence, located approximately 100 feet southwest and downgradient of the Site. The residence was found to have a drinking water well (approximately 45 feet deep) and an irrigation well (approximately 32 feet deep), with concentrations of tetrachloroethene (PCE) of 5,500 micrograms per liter (ug/l) and 29,000 ug/l, respectively.

In order to investigate the PCE concentrations detected in groundwater described above, the NCDOH performed an inspection of the Site in April 1990 when soil samples collected from cracks and gaps within the building basement exhibited PCE concentrations as high as 9,400 ug/kg. In addition, soil samples collected from the rear of the property exhibited PCE concentrations as high as 650,000 ug/kg, trichloroethene (TCE) concentrations as high as 1,700 ug/kg and dichloroethene (DCE) concentrations as high as 680 ug/kg.

Several additional investigations were completed at the Site in order to determine the extent of soil and groundwater contamination. Based on the results of those investigations, a chlorinated-solvent groundwater plume was detected extending from the "source area" at the Site. The groundwater plume was conservatively estimated to be approximately 450 feet wide at the shoulder of the east-bound Southern State Parkway and was concentrated at a depth of approximately 80 to 95 feet below ground surface, immediately above a clay layer. The groundwater plume exhibited elevated concentrations of PCE and its associated breakdown products, including TCE, 1,1-DCE and 1,2-DCE, in exceedance of their respective Class GA Standards of 5 ug/l in shallow groundwater at depths of 20 to 26 feet below grade and up to 3,000 feet downgradient of the Site. In addition, elevated concentrations of PCE and its associated breakdown products were detected in deeper groundwater samples at depths of 33 to 87 feet below grade and as far as 4,500 feet downgradient of the Site.

As described above, the GWE&TS was installed at the leading edge of the groundwater plume in order to capture and treat the remaining groundwater contamination. PCE has been detected at average concentrations of 18 ug/l and 98 ug/l in extraction wells EW-1 and EW-2, respectively, since D&B began routine operation of the GWE&TS in September 2004. However, as presented and discussed below, PCE has exhibited declining trends since that time. In addition, PCE has been detected at concentrations ranging from 14 ug/l to 18 ug/l and 46 ug/l to 56 ug/l in extraction wells EW-1 and EW-2, respectively, during the most recent monitoring period (June through August 2011).

In addition, a groundwater monitoring well network, consisting of three wells located in close proximity to the leading edge of the groundwater plume (ASMW-1 through ASMW-3) and four wells located downgradient of the GWE&TS (ASMW-4 through ASMW-7), were installed within the vicinity of the GWE&TS in order to provide for a means to monitor the effectiveness and performance of the GWE&TS. A figure showing the location of the monitoring wells is provided as Figure 2-1.

Recent PCE concentrations detected in the groundwater monitoring wells located in close proximity to the leading edge of the groundwater plume have decreased since September 2004, with ASMW-1 generally exhibiting the greatest PCE concentrations. PCE has not been detected in the groundwater monitoring wells located downgradient of the GWE&TS, with the exception of slight and sporadic concentrations in ASMW-4. However, these PCE detections are likely the result of a change in analytical method from Method 8260 to Method 624. Method 624 utilizes a much lower method detection limit (MDL) for PCE (0.12 ug/l) than does Method 8260 (0.81 ug/l). As sch, similar PCE concentrations may have existed within ASMW-4 for some time, which would have been undetectable utilizing Method 8260. PCE was not detected in the most recent round of groundwater sampling (July 2011). Historic and current PCE concentrations are further discussed in Section 3.1.1.

Based on review of analytical data, the Village of Rockville Centre water supply wells located downgradient of the groundwater monitoring well network continue to exhibit non-detect concentrations of PCE.

As described above, in addition to the installation of the GWE&TS at the leading edge of the plume, "source area" contamination at the Site was remediated via a SVE/AS system, which operated from November 2003 to August 2004. The SVE/AS system was shut down in August 2004 based on contaminant concentrations below NYSDEC guidelines. Further details regarding the "source area" remediation are provided in the draft Final Remediation Report for the Franklin Cleaners On-site SVE/AS, dated June 2009.

2.1.3 Conceptual Site Model/Potential Receptors

Conceptual Model

As presented above, the GWE&TS was installed at the leading edge of the groundwater plume in order to capture and treat any remaining contamination. Based on various extraction scenarios modelled as part of a 1999 to 2000 Pre-Design Investigation (PDI), the minimum required pumping rate required for the GWE&TS to capture the approximately 450-foot wide leading edge of the groundwater plume is 20 gpm in either a one or two-well pumping scenario. However, since the extraction scenario modeling was based on a simplification of actual site conditions and utilized several assumptions, extraction wells EW-1 and EW-2 have been operating at average flow rates of 37 gpm and 4.8 gpm, respectively, since system start-up in September 2004, in order to provide for a factor of safety. The lower operating flow rate of extraction well EW-2 is the result of a silty clay soil unit within the well screen zone. Due to the relatively high concentrations of VOCs detected in samples collected from the screened interval of the well during installation, the NYSDEC decided to keep the extraction well at this location and depth, and required the well to be pumped at its maximum yield.

As presented in Section 2.3, contaminated groundwater is captured by the GWE&TS via two extraction wells (EW-1 and EW-2), which convey the contaminated groundwater to a low-profile stacked-tray air striper. The air stripper removes the volatile components of the groundwater and the treated groundwater is discharged to a Nassau County Department of Public Works (NCDPW) storm sewer manhole in accordance with all applicable discharge standards.

Exhaust gas from the air stripper was initially treated utilizing granular activated carbon (GAC) vessels. However, based on historic low contaminant concentrations detected in the air stripper exhaust gas, the air stripper exhaust piping was reconfigured to discharge exhaust gas directly to the atmosphere in June 2011, per the direction of the NYSDEC.

As described further in Section 2.3.6, a groundwater monitoring well network, consisting of three wells located in close proximity to the leading edge of the groundwater plume (ASMW-1 through ASMW-3) and four wells located downgradient of the GWE&TS (ASMW-4 through ASMW-7), was installed in the vicinity of the GWE&TS in order to provide for a means to monitor the effectiveness and performance of the GWE&TS. A figure showing the location of the monitoring wells is provided as *Figure 2-1*.

Potential Receptors

Exposure of potential receptors to Site-related contamination is mitigated and/or eliminated by the following:

- The GWE&TS building and property is completely fenced and locked at all times, eliminating public access to the Site and building. Access to the Site is limited to the NYSDEC and its approved contractors;
- A groundwater use restriction does not currently exist at the Site; however, Site groundwater is not used for any purpose and is only handled/sampled in small quantities by trained sample technicians on a bi-weekly basis;
- In general, properties located upgradient of the GWE&TS and within the vicinity of the groundwater plume, are serviced by public water supply. Molloy College, located immediately downgradient of the leading edge of the groundwater plume, is also serviced by public water supply. As described in Section 2.3.6, irrigation/groundwater monitoring well ASMW-7 has been installed at Molloy College for use, if needed, to supplement irrigation water provided by public water supply. Note that VOCs have been non-detect in ASMW-7 since routine sampling of this well was initiated in 2004. In addition, ASMW-7 has never been used by Molloy College and it is not anticipated that Molloy College will utilize this well for the foreseeable future; and
- Review of sample analytical documentation from the Village of Rockville Centre indicates that VOCs have not been detected in the public supply wells located downgradient of the GWE&TS since system start-up in September 2004. In addition, "sentinel" monitoring wells ASMW-4 through ASMW-7 have not exhibited detections of any VOCs since system start-up, with the exception of intermittent slight PCE detections in ASMW-4. Note that these detections have been attributed to a change in the analytical method from Method 8260 to Method 624, which utilized a lower MDL for PCE than Method 8260.
- Since system start-up in September 2004, concentrations of PCE in aqueous-phase effluent discharged by the GWE&TS have ranged from nondetect to a maximum concentration of 1 ug/l, with an average concentration of 0.5 ug/l, well below its site-specific effluent limit of 5.0 ug/l;
- As VOC concentrations within vapor-phase effluent have not exceeded the site-specific effluent limit of 0.5 pounds per hour (lbs/hr) at any time since system start-up, exposure of potential receptors to harmful concentrations of site-related contamination via vapor-phase effluent generated by the GWE&TS has not occurred since system start-up and is not expected to occur in the future; and
- Based on the depth of site-related contamination in groundwater (approximately 80 to 95 feet below grade) and the relatively low contaminant concentrations currently detected in extracted groundwater, soil vapor associated with site-related contamination is not expected to be encountered at the Site. As described above "source area" contamination was remediated via a SVE/AS system. The SVE/AS system was shut down in August 2004 based on contaminant concentrations detected below NYSDEC guidelines. In addition, a subslab depressurization system (SSDS) was installed within the former dry cleaner building basement in January 2007 to address elevated concentrations of chlorinated VOCs detected in the soil immediately beneath the building floor slab following the decommissioning of the AS/SVE system. Based on available records, the operation of the SSDS is the responsibility of the property owner, and based on a Site inspection conducted on February 14, 2012, the SSDS still exists at the Site and is currently operating as designed.

2.2 Summary of Remedial Investigations and Actions

A summary of the remedial investigation program and interim and long-term remedial measures completed at the Site "source area" is provided in the NYSDEC-approved RSO Background Search and Site Inspection Summary Letter-Report, dated December 6, 2011. The RSO Background Search and Site Inspection Summary Letter-Report is provided in *Attachment A*.

2.3 Groundwater Extraction and Treatment System Description

2.3.1 Process and Instrumentation

An as-built system diagram of the GWE&TS is provided as *Figure 2-2*.

Contaminated groundwater is extracted from two 6-inch diameter extraction wells (EW-1 and EW-2), screened at approximately 70 to 90 feet below grade and 75 to 90 feet below grade, respectively. Groundwater is pumped from extraction wells EW-1 & EW-2 via Grundfos Model 25E3 and 5E8 submersible pumps, respectively. Each extraction well pump is controlled with a Sysdrive Model 3G3JV variable frequency drive (VFD) to modulate its flow rate.

Extracted groundwater is conveyed to the GWE&TS building via 2-inch diameter underground PVC piping. The extracted groundwater is then directed to the top of a Carbonair STAT180 low-profile stacked-tray air stripper, where it flows by gravity through a total of five perforated aeration trays within the air striper. While the extracted groundwater flows through the air stripper, counter-current air generated by a New York Blower Model 2506A pressure blower is directed into the bottom of the air striper and is forced up through the perforations in each stacked-tray. The pressure blower is equipped with an integral outlet dampener, which can be used to modulate its air flow rate. This process allows for the volatization, or "mass transfer," of volatile components within the groundwater from an aqueous-phase to a vapor-phase.

The treated groundwater is then discharged from the air stripper to a wet well equipped with two Flygt Model CP 3085 submersible pumps, which are programmed to operate "one-at-a-time," in an alternating cycle. These submersible pumps convey the treated water via 4-inch ductile iron and 3-inch PVC underground piping to a NCDPW storm sewer manhole in accordance with all applicable discharge standards. The submersible wet well pumps do not include an integral control to modulate the effluent flow rate; however, a 4-inch diameter gate valve is installed downstream of each pump, which allows for the modulation of their respective flow rates.

Exhaust gas from the air stripper was initially treated utilizing two 1,000 pound Tetrasolv Model VF1000 GAC vessels, which are configured in series. However, it should be noted that, based on historic low contaminant concentrations detected in the air stripper exhaust gas, the air stripper exhaust piping was reconfigured to discharge exhaust gas directly to the atmosphere in June 2011, per the direction of the NYSDEC.

Each major component of the GWE&TS is equipped with several gauges to monitor temperature, pressure and aqueous/vapor-phase flow, as appropriate. In addition, the GWE&TS is equipped with controls which allow for automated start-up and operation and an autodial alarm notification system.

2.3.2 Design Criteria

The GWE&TS was designed to treat aqueous-phase PCE in extracted groundwater from a maximum concentration of 1,200 ug/l to a concentration of no more than 1.0 ug/l, prior to discharge. The GWE&TS was designed to achieve this contaminant removal efficiency at a maximum groundwater influent flow of 70 gpm and a maximum fresh air influent flow rate of 650 standard cubic feet per minute (scfm).

Based on extraction scenario modeling completed during the PDI, the minimum required pumping rate required for the GWE&TS to capture the approximately 450-foot wide leading edge of the groundwater plume is 20 gpm in either a one or two-well pumping scenario. However, since the extraction scenario modeling was based on a simplification of actual site conditions and utilized several assumptions, extraction wells EW-1 and EW-2 have been operating at respective average flow rates of approximately 37 gpm and 4.8 gpm since system start-up in September 2004, in order to provide for a factor of safety. The lower operating flow rate of extraction well EW-2 is the result of a silty clay soil unit within the well screen zone. Note, due to the relatively high concentrations of VOCs detected in samples collected from the screened interval of the well during installation, the NYSDEC decided to keep the extraction well at this location and depth, and required the well to be pumped at its maximum yield.

Based on discussions with the NYSDEC, a State Pollution Discharge Elimination System (SPEDES) permit was not required with respect to the discharge water generated by the GWE&TS, as this is a New York State Superfund project. However, compliance with the substantive requirements of the SPEDES regulations was required. As such, a SPDES permit equivalency, outlining aqueous-phase effluent limits and monitoring requirements for the GWE&TS is provided in *Attachment B*. As it was initially anticipated that the major system components would include metals treatment for iron and manganese and pH adjustment, these parameters are listed on the SPDES permit along with several chlorinated VOCs, including PCE. Note, the discharge limit for PCE, the site-specific contaminant of concern, is 5 ug/l.

As treatment of the vapor-phase effluent generated by the GWE&TS is no longer required, the design criteria of the GAC system are not discussed.

2.3.3 Operating Parameters

The current operating parameters for the major GWE&TS components are as follows:

- Extraction well EW-1 has been operating at an average flow rate of approximately 34.7 gpm;
- Extraction well EW-2 currently operates at an average flow rate of approximately 6.5 gpm (as presented below, extraction EW-2 is flow limited to approximately 7 gpm);
- The pressure blower currently operates at an average flow rate of approximately 875 cubic feet per minute (cfm) (the pressure blower was designed to operate at approximately 650 cfm); and
- The submersible wet well pumps within the wet well each currently operate at a flow rate ranging between approximately 60 to 68 gpm.

As mentioned above, a SPDES permit equivalency outlines aqueous-phase effluent limits and monitoring requirements. The site-specific vapor-phase discharge limit, developed in consultation with the NYSDEC to monitor total vapor-phase VOCs discharged by the GWET&TS, is 0.5 lbs/hr.

2.3.4 Operation and Maintenance

In accordance with the requirements of the October 2003 Franklin Cleaners Site Operations and Maintenance Manual (OMM), the operation and maintenance (O&M) scope of services for the GWE&TS consists of general facility maintenance, routine treatment system maintenance, non-routine treatment system maintenance and system alarm/shutdown response, as detailed below:

General Facility Maintenance

General facility maintenance work items are those tasks which involve the maintenance and upkeep of the GWE&TS facility, as well as groundskeeping of the GWE&TS facility property. The scope of services for general facility maintenance includes, but is not limited to, the following:

- Providing snow removal services on an as-needed basis;
- Replacement of bulbs for emergency and area lighting on an as-needed basis;
- Cleaning of the air stripper inlet vent screen on an as-needed basis;
- Cleaning of the building louver inlet vent screen on an as-needed basis;
- Removal of on-site overgrown vegetation on an as-needed basis;
- Replenishment of expendable O&M supplies on an as-needed basis; and
- Providing general facility housekeeping on an as-needed basis.

Routine Maintenance

Routine maintenance consists of tasks which involve scheduled inspection and maintenance of the GWE&TS equipment and appurtenances and ensuring that all GWE&TS components are maintained in accordance with the manufacturer's operations and maintenance manuals. The scope of services for the routine operating includes, but is not limited to, the following:

- Weekly monitoring of system equipment (extraction well pumps, low profile stacked-tray air stripper and pressure blower);
- Weekly inspection of all equipment, piping, flanges, valves, instruments, etc. for leakage, unusual noise and proper working condition;
- Once per every other month inspection and routine preventive maintenance of the pressure blower unit;
- Annual inspection and maintenance of the wet well pumps;
- Annual inspection and maintenance of the pressure washer and containment island assembly;
- As-needed disassembly, cleaning and reassembling of the low-profile air stripper unit based on total pressure loss through the air stripper (differential pressure); and
- As-needed removal and replacement of the carbon within the GAC vessels based on total VOC screening results utilizing a PID at the vessel outlets (as noted above, the GAC vessels are no longer being utilized due to low contaminant concentrations in vapor-phase discharge).

Non-Routine Maintenance

Non-routine GWE&TS maintenance consists of tasks which involve out of scope maintenance and upkeep of the GWE&TS equipment. Non-routine maintenance is conducted in response to GWE&TS shutdown conditions and as a result of decreased equipment performance, as appropriate.

System Alarms

The GWE&TS is equipped with an alarm notification system to indicate when the GWE&TS is not operating properly, as well as an auto-dialer, which is programmed to call-out a predetermined sequence of phone numbers in the event of an alarm. The following is a list of the current alarms for the system:

- Alarm #1 – Temperature Alarm
- Alarm #2 – Building Entry Alarm
- Alarm #3 – General System Alarm
- Alarm #4 – General Failure Submersible Pump (Wet Well) Alarm
- Alarm #5 – General Failure EW-1/EW-2 Alarm
- Alarm #6 – Pressure Blower Failure Alarm
- Alarm #7 – High Level Air Stripper Sump Alarm
- Alarm #8 – High Level Valve Vault Sump Alarm

2.3.5 Process Monitoring and Sampling

The overall GWE&TS and its various components are monitored in order to evaluate the efficiency of the overall GWE&TS and its major components. Pressure, temperature and flow rate data are collected from the major GWE&TS components on a weekly basis, as appropriate. A complete list of monitoring parameters is provided on Table 2-1.

In addition, various aqueous-phase and vapor-phase process samples are collected from the GWE&TS in order to evaluate the overall efficiency of the GWE&TS and its various components, while at the same time, ensuring that all GWE&TS discharges are below/within applicable standards and/or site-specific limits. Site-specific sampling locations, frequencies and analytical parameters are summarized on *Table 2-2*.

All GWE&TS process and groundwater samples collected from system start-up in September 2004 through January 2010 were submitted to Mitkem Corporation (Mitkem) for analysis. All samples collected from February 2010 through the present were submitted to Test America Laboratories (TAL) for analysis. Both laboratories are NYSDOH Environmental Laboratory Approval Program (ELAP)-certified laboratories. The laboratory data packages are reviewed for completeness and compliance with NYSDEC Analytical Services Protocol (ASP) Quality Assurance/Quality Control (QA/QC) requirements. Any QA/QC issues arising with the sample results have been qualified as part of the routine Site Management Quarterly Monitoring Reports.

2.3.6 Groundwater Monitoring

Groundwater monitoring wells ASMW-1, ASMW-2 and ASMW-3 have been installed in the vicinity of the extraction wells to monitor groundwater conditions immediately downgradient of the leading edge of the groundwater plume. Groundwater monitoring wells ASMW-4, ASMW-5, ASMW-6 and ASMW-7 have been installed downgradient of the GWE&TS and upgradient of the Village of Rockville Centre water supply wells in order to act as ‘sentinel’ wells for Rockville Centre supply wells and to ensure the GWE&TS is effectively capturing the groundwater plume.

As detailed on *Table 2-2*, groundwater monitoring and sampling is performed on a quarterly basis and all collected groundwater samples are analyzed for TCL VOCs via Method 624.

2.4 Remedial Goals/Cleanup Objectives

The remedial goals and cleanup objectives were established by the NYSDEC in accordance with the remedy selection process as defined in 6 NYCRR Part 375-1.10. As stated in the ROD, the overall goal of the remedial program is to meet all applicable Standards, Criteria and Guidelines (SCGs) and eliminate or mitigate all significant threats to public health and the environment.

Based on this overall remedial goal, the following site-specific remedial goals were selected:

- Reduce, control, or eliminate contaminated media to the extent practicable;
- Eliminate the threat to groundwater and indoor air by eliminating Site “source area” soil contamination;
- Eliminate the potential for human exposure to the Site “source area” contaminated soils;
- Eliminate the potential for exposure to contaminated groundwater; and
- Provide for attainment of SCGs for groundwater, soil and indoor air to the limits of the affected area, to the extent practicable.

Note, some of these remedial goals are associated with the Site “source area” contamination only, and do not pertain to the groundwater plume and GWE&TS remedy.

3.0 FINDINGS

3.1 Extraction System Performance

Provided below, is an evaluation of the performance of the extraction portion of the GWE&TS. As part of this evaluation, PCE concentrations in all extraction and monitoring wells, plume containment and any limitations regarding the performance of the GWE&TS are assessed, as follows:

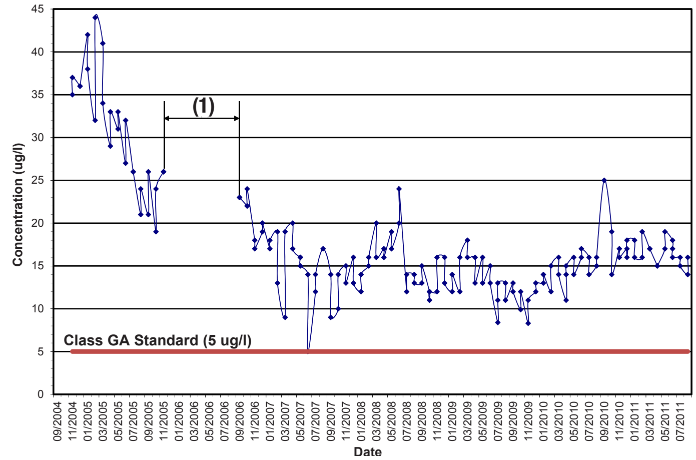
3.1.1 Contaminant Trends - Extraction and Monitoring Wells

Extraction Wells

Extraction wells EW-1 and EW-2 were installed at the leading edge of the groundwater plume emanating from the Site in order to capture the plume. PCE, the site-specific contaminant of concern, has been detected in exceedance of its Class GA Groundwater Standard of 5 ug/l in both extraction wells since start-up of the GWE&TS in September 2004. Historical PCE concentration trends within each extraction well are presented below. In addition, graphs depicting the historical PCE concentration trends within extraction wells EW-1 and EW-2 are provided as below.

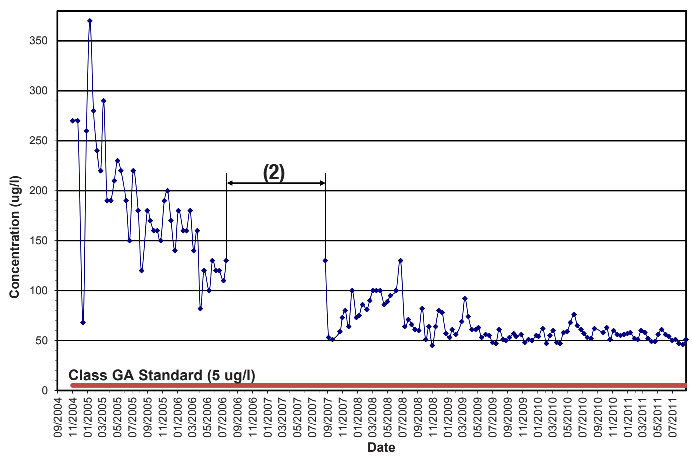
- EW-1: Concentrations of PCE have ranged between 5 ug/l and 44 ug/l since system start-up. Overall, PCE concentrations in extraction well EW-1 have decreased since system start-up, but remain above the Class GA Groundwater Standard of 5 ug/l. In addition, concentrations of PCE have shown a slightly increasing trend since December 2009;
- EW-2: Concentrations of PCE have ranged between 45 ug/l and 370 ug/l since system start-up. Overall, PCE concentrations in extraction well EW-2 have decreased since system start-up, but remain above the Class GA Groundwater Standard of 5 ug/l. However, concentrations of PCE appear to have stabilized from the latter portion of 2009 to the present.

Figure 3-1
Extraction Well EW-1 PCE Concentration Trend Line



1. EW-1 not operational from 11/5/05 - 9/7/06 due to failure of extraction pump

Figure 3-2
Extraction Well EW-2 PCE Concentration Trend Line



2. EW-2 not operational from 7/25/06 - 8/30/07 due to failure of extraction pump

Monitoring Wells

As presented in Section 2.0, the groundwater monitoring well network was installed in the vicinity of the GWE&TS in order to provide for a means to monitor the effectiveness and performance of the GWE&TS. The groundwater monitoring well network consists of three monitoring wells (ASMW-1 through ASMW-3) located in the vicinity of the leading edge of the groundwater plume and four monitoring wells (ASMW-4 through ASMW-7) located downgradient of the GWE&TS. Note that the four downgradient monitoring wells (ASMW-4 through ASMW-7) also act as “sentinel” wells for a Village of Rockville Centre production well cluster located downgradient of the GWE&TS.

PCE has only been detected in monitoring wells ASMW-1 through ASMW-4, with PCE concentrations in these wells generally exhibiting a decreasing trend since system start-up in September 2004. PCE concentrations detected in the monitoring well network are summarized below. In addition, graphs depicting PCE concentrations in monitoring wells ASMW-1 through ASMW-3 are provided below.

- ASMW-1: Concentrations of PCE have ranged between non-detect and 30 ug/l since system start-up. Overall, PCE concentrations have decreased in groundwater monitoring well ASMW-1; however, not as substantially as has been seen in the other monitoring wells located in close proximity to the leading edge of the groundwater plume (ASMW-2 and ASMW-3). In addition, PCE concentrations within ASMW-1 have exhibited a slightly increasing trend since

August 2009, indicating that the groundwater plume may be shifting slightly to the west. The most recent PCE concentration detected in ASMW-1 is 16 ug/l (July 2011);

- ASMW-2: Concentrations of PCE have ranged between 2.1 ug/l and 100 ug/l since system start-up. Concentrations of PCE have substantially decreased since system start-up and are trending toward a concentration below the Class GA Standard of 5 ug/l. The most recent PCE concentration detected in ASMW-2 is 4.9 ug/l (July 2011);
- ASMW-3: Concentrations of PCE have ranged between non-detect ug/l and 3.2 ug/l, and have consistently remained at concentrations below the Class GA Standard of 5 ug/l since system start-up. PCE was not detected in the most recent groundwater sampling event (July 2011);
- ASMW-4: Concentrations of PCE have consistently been non-detect since system start-up; however, PCE has recently been detected in monitoring well ASMW-4 at concentrations ranging from 0.16 ug/l to 0.27 ug/l, significantly below its Class GA Groundwater Standard of 5 ug/l. PCE was not detected in monitoring well ASMW-4 in the most recent ground water sampling event (July 2011). D&B believes these detections are attributed to a change of analytical methods for VOCs from USEPA Method 8260 to Method 624, as Method 624 has a lower PCE method detection limit (MDL) of 0.12 ug/l, compared to the MDL for Method 8260 of 0.81 ug/l. In addition, the Village of Rockville Centre public supply wells 4A, 4B and 4C, located downgradient of the GWE&TS and groundwater monitoring well network, continue to exhibit non-detect concentration of PCE; and
- Groundwater monitoring wells ASMW-5, ASMW-6 and ASMW-7 have not exhibited a detectable concentration of PCE since system start-up.

3.1.2 Extraction Well Pump Test

A pump test was undertaken from November 30 to December 2, 2011 in an effort to evaluate the "radius of influence" of the GWE&TS. All pump test field work was completed by a NYSDEC "call-out" contractor and D&B was on-site to perform spot checks during the pump test.

As part of the pump test, pressure transducers with data logging capabilities were installed in groundwater monitoring wells ASMW-1, ASMW-2 and ASMW-3, as well as within three existing pump test monitoring wells

Figure 3-3
Monitoring Well ASMW-1 PCE Concentration Trend Line

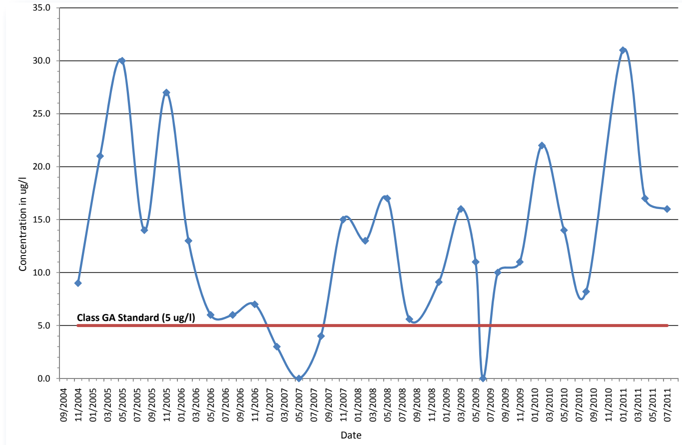


Figure 3-4
Monitoring Well ASMW-2 PCE Concentration Trend Line

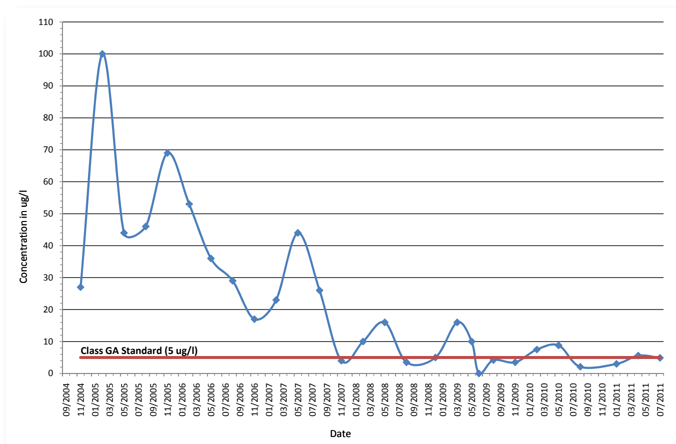
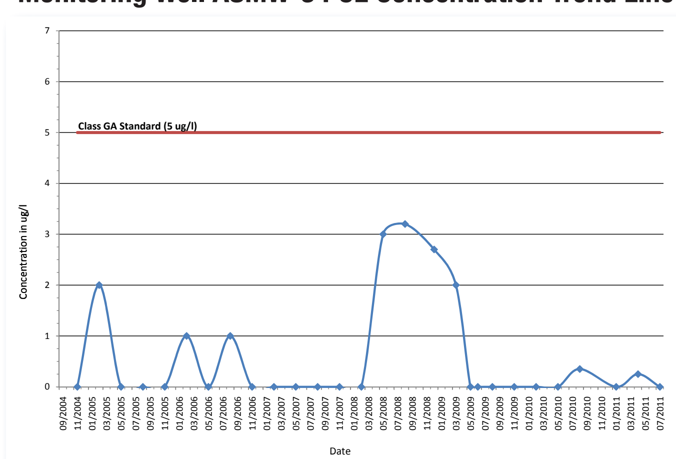


Figure 3-5
Monitoring Well ASMW-3 PCE Concentration Trend Line



(PTMW-01, PTMW-02 and PTMW-03), which had been installed along the southern shoulder of the Southern State Parkway as part of the PDI. The locations of the extraction wells, monitoring wells and pump test wells are provided on Figure 3-6. Monitoring wells are considered within the extraction wells "radius of influence" if 0.1-foot or greater vertical water elevation change is observed within the monitoring well while the extraction well is pumping.

The pressure transducers were programmed to begin collecting and storing time and groundwater level data at linear 5-minute intervals; therefore, capturing both static groundwater level and drawdown data. In order to provide data for various pumping scenarios, the pump test of extraction well EW-1 was completed at four successively increasing flow rates of 20, 25, 30 and 35 gallons per minute (gpm). The groundwater level in all monitoring wells was allowed to stabilize for generally three consecutive readings prior to increasing the flow rate to the next increment. The GWE&TS was then shut down for a period of 24 hours prior to initiating the pump test of EW-2. As previously stated, the presence of a silty and clayey soil unit within the screened interval of extraction well EW-2 limits EW-2 to a maximum flow rate of approximately 7 gpm. Therefore, the pump test of EW-2 was performed at 7 gpm only. The maximum drawdown values observed in each monitoring and pump test well, as well as distances of each monitoring and pump test well from each extraction well, are provided below.

Table 3-1: Summary of Pump Test Maximum Drawdown Values (1)

Monitoring Point	ASMW-1 (2)	ASMW-2	ASMW-3	PTMW-1	PTMW-2	PTMW-3
Extraction Well EW-1						
Distance from EW-1	215	75	115	32	10	48
Drawdown at 20 gpm (3)	0.113	0.372	0.092	0.455	0.973	0.478
Drawdown at 25 gpm	0.132	0.467	0.127	0.571	1.21	0.596
Drawdown at 30 gpm	0.171	0.568	0.162	0.691	1.47	0.725
Drawdown at 35 gpm	0.199	0.670	0.192	0.815	1.71	0.850
Extraction Well EW-2						
Distance from EW-2	105	72	230	152	110	70
Drawdown at 7 gpm	0.215	0.180	0.053	0.090	0.122	0.238

1. Flow rates are approximate and all measurements provided in feet.

2. Click on Monitoring point names to see graphical representations of the EW-1 pump test drawdown results.

3. gpm: gallons per minute.

Based on a recommendation to reduce EW-1's flow rate to 30 gpm, as provided in Section 4.0 of this RSO, the below discussion is based on extraction well EW-1 pumping at 30 gpm.

As a time-drawdown aquifer test completed as part of the GWE&TS design already established key aquifer parameters such as hydraulic conductivity (30 ft/day), storativity (0.2) and transimssivity (2,160 ft/day) in the vicinity of the extraction and pump test wells, this pump test focused on confirming that the "radius of influence" created by the extraction wells encompasses all monitoring and test wells located within the vicinity of the GWE&TS and that the "capture zone" created by the extraction wells was sufficient to capture the lateral extent of the groundwater plume.

Based on the pump test results detailed on Table 3-1, extraction well EW-1 pumping at 30 gpm and extraction well EW-2 pumping at 6.5 gpm influence all monitoring and pump test wells. In addition, based on the key aquifer parameters discussed above and current extraction well pumping rates, extraction well EW-1 pumping at 30 gpm and extraction well EW-2 pumping at 6.5 gpm create a "capture zone" of greater than 1,000 feet in width. The estimated extent of the extraction well "capture zone" is depicted on Figure 3-6. Plume containment is further discussed below.

3.1.3 Plume Containment

Based on extraction scenario modeling detailed in the December 2000 Design Report, the minimum required pumping rate required for the GWE&TS to capture the approximately 450-foot wide leading edge of the groundwater plume is 20 gpm in either a one or two-well pumping scenario. However, since the extraction scenario modeling was based on a simplification of actual Site conditions and utilized several assumptions, extraction wells EW-1 and EW-2 have been operating at respective average flow rates of 37 gpm and 4.8 gpm since system start up in September 2004, in order to provide a factor of safety. The lower operating flow rate of extraction well EW-2 is the result of a silty clay soil unit within the well screen zone. Note, due to the relatively high concentrations of VOCs detected in samples collected from the screened interval of the well during installation, the NYSDEC decided to keep extraction well EW-2 at this location and depth, and required the well to be pumped at its maximum yield.

Based on the key aquifer parameters discussed above and current extraction well pumping rates, extraction well EW-1 pumping at 30 gpm and extraction well EW-2 pumping at 6.5 gpm create a "capture zone" of greater than 1,000 feet in width, encompassing all tested monitoring wells and the approximate 450-foot wide groundwater plume. The estimated extent of the extraction well "capture zone" and plume width, as detailed in the December 2000 Design Report, are depicted on *Figure 3-6*.

As monitoring well ASMW-1 typically exhibits elevated PCE concentrations, this may indicate that the groundwater plume has shifted slightly to the west, as compared to its initial location described in the December 2000 Design Report. However, note that the "capture zone" calculated utilizing the key aquifer parameters discussed above extends well beyond monitoring well ASMW-1. In addition, PCE has not been detected in any "sentinel" early warning well or the Rockville Centre production wells located downgradient of the GWE&TS since system start-up in September 2004, with the exception of a slight detection in monitoring well ASMW-4, as described above.

The slight PCE detections noted in monitoring well ASMW-4 are attributed to the change in analytical method from Method 8260 to Method 624. As detailed in Section 2.1.2, Method 624 utilizes a much lower MDL (0.12 ug/l) for PCE than does Method 8260 (0.81ug/l). As such, similar PCE concentrations may have existed within ASMW-4 for some time, which would have been undetectable utilizing Method 8260. In addition, based on the depth of the Rockville Centre production wells (an average of approximately 550 feet in depth) and their lateral distance from the leading edge of the groundwater plume at the GWE&TS (approximately 1,250 feet), it is unlikely that these production wells are having significant, if any, influence on the groundwater plume or PCE concentrations downgradient of the GWE&TS.

In addition, based on review of the extraction well "capture zone" and consistent non-detect concentrations of PCE in monitoring well ASMW-3, extraction well EW-1, operating in excess of 30 GPM, would be extracting a relatively high component of "clean" groundwater from the eastern portion of its "capture zone."

Lastly, it is estimated that the "tail end" of the groundwater plume will reach the GWE&TS in approximately September 2012 based on the following factors:

- The Site "source area" is located approximately 0.8 miles, or 4,400 feet upgradient of the GWE&TS;
- Site "source area" soil and groundwater contamination was successfully remediated to concentrations below their respective SCGs in August 2004;
- It is estimated that the migration rate for chlorinated solvents in groundwater is approximately 1.5 feet per day in this area of Long Island;
- Note that the groundwater plume migration rate of 1.5-feet per day is an approximation and is influenced by the hydraulic conductivity and transmissibility of the aquifer, based on soil grain size, distribution and clay content, etc. In addition, note that localized areas of higher contaminant concentrations in the vicinity of and/or downgradient of the Site "source area," due to adsorption and release of contaminants within clay-rich portions of the aquifer, may also effect the rate at which the "tail end" of the groundwater plume will reach the GWE&TS.

3.1.4 Performance Limitations

Several limitations exist which may limit the efficiency, effectiveness, and/or performance of the GWE&TS, as detailed below:

- Extraction Well EW-2 Flow: As described in Section 2.0, the screened interval of extraction well EW-2 is installed within a localized silt and clay-rich soil unit, substantially limiting EW-2's yield potential. Note, due to the relatively high concentrations of VOCs detected in samples collected from the screened interval of the well during installation, the NYSDEC required that the extraction well remain at this location and depth, and required the well to be pumped at its maximum yield;
- Clayey Soil Intervals: As detailed in the December 2000 Design Report, the initial plume delineation program concluded that the groundwater plume extending from the Site was concentrated at a depth of 80 to 95 feet below grade, immediately above a clay layer. However, based on review of the extraction well and monitoring well boring logs, it appears that this and other clay layers and clay-rich soil units described in the Site extraction and monitoring well boring logs may be discontinuous;
- Based on the limited number of monitoring wells to the south and west of the GWE&TS building, limited groundwater contaminant concentration data can be collected from these areas. As a result, the potential slight shift in the groundwater plume location to the west as compared to its initial location described in the December 2000 Design Report may not be detectable utilizing the current groundwater monitoring well network. Note that, based on the depth of the screened intervals of the Rockville Centre production wells (approximately 400 to 460, 542 to 592 and 544 to 604 feet below grade) and their lateral distance from the leading edge of the groundwater plume at the GWE&TS (approximately 1,250 feet), these production wells are not likely hydraulically "connected" to the groundwater plume or the GWE&TS extraction and monitoring wells.

3.2 Treatment System Performance

Provided below, is an evaluation of the performance of the treatment portion of the GWE&TS. As part of this evaluation, the operational history of the GWE&TS, the major system components, system maintenance history, mass removal efficiencies, discharge compliance, system downtime and process waste are assessed, as follows:

3.2.1 Operational History

Operational history consisting of runtimes and downtimes, gallons of water extracted and pounds of VOCs removed are presented below:

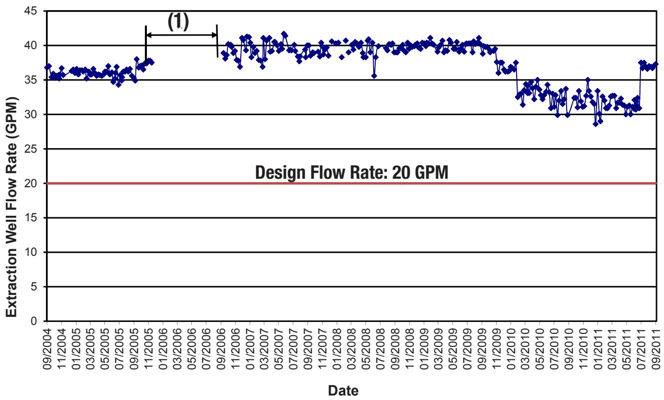
Table 3-2: System Extraction Rates and Total Flow Volumes

	EW-1	EW-2	System Influent (2)	System Effluent (2)
Average Current Pumping Rate(1)	34.7 gpm	6.5 gpm	41.2 gpm	62.8 gpm
Average Pumping Rate to Date	36.8 gpm	4.7 gpm	37.1 gpm	70.7 gpm
Total Current Flow Volume(1)	4,563,778 gal.	829,304 gal.	5,393,081 gal.	7,772,809 gal.
Total Flow Volume to Date	125,065,153 gal.	15,284,445 gal.	140,349,598 gal.	178,153,189 gal.

1. Current reporting period is June through August 2011. Not that extraction well EW-2 flow was not recorded during the majority of this reporting period due to consistent malfunctions of the EW-2 paddle wheel-style flow meter. Extraction well (EW-1 and EW-2) flow meters were replaced with mag-style flow meters on June 23, 2011.

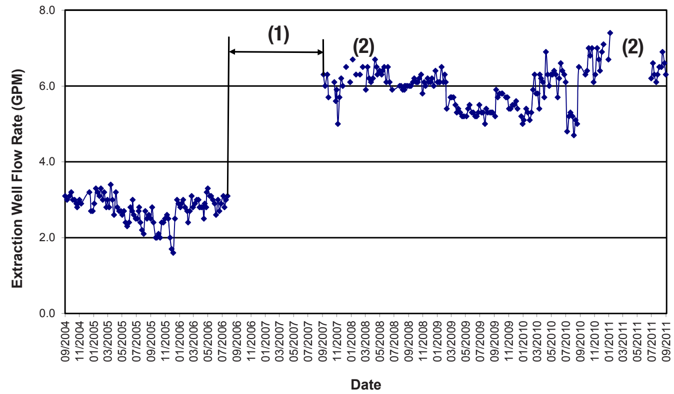
2. System influent and effluent pumping rates and volumes are monitored on a bi-weekly basis. The system effluent total flow volume is not consistent with the system influent. Note that the influent flow rate readings collected following the replacement of the influent flow meters are consistent with historical flow readings, indicating that the current influent/effluent flow inconsistencies may be the result of a malfunctioning effluent flow meter.

Figure 3-13
Extraction Well EW-1 Average Flow Rate



1. EW-1 not in operation from 11/15/05 - 7/25/06 due to failure of the extraction pump

Figure 3-14
Extraction Well EW-2 Average Flow Rate



1. EW-2 not in operation from 7/25/06 - 8/30/07 due to failure of the extraction pump

2. Intermittent data gaps are due to malfunctioning of influent flow meter

Table 3-3: VOC Removal Assessment	
VOC Removal - Current Monitoring Period	0.85 lbs.
Average VOC Removal to Date (per monitoring period)	0.87 lbs.
Total VOC Removal to Date	44.5 lbs.

The GWE&TS has been operating since September 2004. Since this time, the GWE&TS has operated for approximately 60,710 hours and has experienced a total of approximately 6,241 hours of downtime. A summary of the factors contributing to this downtime is provided below in Section 3.3.6.

Since system start-up in September 2004, the GWE&TS has extracted and treated a total of approximately 178,155,484 gallons of contaminated groundwater. Note that the GWE&TS was originally equipped with paddle wheel-style flow meters to monitor influent flow rate and volumes. The influent flow meters have consistently malfunctioned over the course of the past several years, likely due to a relatively high iron content in the extracted groundwater. As such, the total treated water volume provided above was recorded from the system effluent flow meter, which is a more robust "mag-style" meter. The paddle wheel-style influent flow meters were replaced with "mag-style" flow meters on June 23, 2011.

The GWE&TS has removed a total of approximately 44.5 lbs of total VOCs since system start-up in September 2004, with an average VOC removal rate of 0.96 lbs of total VOCs per month, based on the most recently reported quarter of operation (Site Management Quarterly Report No. 27). The GWE&TS's PCE mass removal efficiency has ranged from approximately 90% to 99.84% (at an average mass removal efficiency of 98.87%) since system start-up.

3.2.2 Engineering Evaluation of Major System Components

The GWE&TS was designed to capture and treat contaminated groundwater emanating from the Site, and reduce PCE in the extracted groundwater from a maximum inlet concentration of 1,200 ug/l to an effluent concentration of no greater than 1 ug/l, at a maximum flow rate of 70 gpm. As described in the ROD dated March 1998, air stripping is the treatment technology that was selected for removal of VOCs from the groundwater. Based on pre-design calculations, a discharge concentration of less than 0.5 ug/l PCE was expected to be achievable with the selected low-profile stacked-tray air stripper. This provided a factor of safety with respect to the site-specific effluent limit for PCE of 5 ug/l. Though no longer in-use, as described below, granular activated carbon (GAC) was used to treat the exhaust gas from the air stripping process prior to discharge to the atmosphere.

The major system components of the GWE&TS consist of the following:

- Extraction wells and pumps;
- Low-profile stacked-tray air stripper;
- Pressure blower;
- Wet well submersible pumps; and
- Vapor-phase granular activated carbon vessels.

Presented below, is the engineering evaluation of each major system component:

Extraction Wells and Pumps

Extraction wells EW-1 (including a Grundfos Model 25E3 extraction pump) and EW-2 (including a Grundfos Model 5E8 extraction pump) were installed along the leading edge of the groundwater plume and are screened at a depth of 70-90 and 75-90 feet below grade, respectively.

Pump test and groundwater flow/capture zone modeling completed as part of the PDI determined that a minimum required flow rate of 20 gallons per minute (gpm), utilizing a one or two-well pumping scenario, would be sufficient for plume containment. However, extraction wells EW-1 and EW-2 have been operating at flow rates of 37 gpm and 4.8 gpm, respectively, since system start up in September 2004. Over the course of the most recent year of operation, extraction wells EW-1 and EW-2 operated at approximately 80 and 60 Hertz (Hz), respectively, in order to maintain their respective current flow rates of approximately 34.7 and 6.5 gpm. Based on review of the pump manufacturer's pump performance curves, both extraction well pumps are currently operating efficiently at their current flow rates and within their design and manufacturer's specifications.

The submersible pumps and motors within extraction wells EW-1 and EW-2 have generally operated reliably since system start-up in September 2004. However, it should be noted that each pump was replaced on separate occasions due to various electric/mechanical failures of each pump. Further detail regarding the extraction well pump electric/mechanical failures and associated downtime is discussed in Section 3.0.

Low-Profile Stacked-Tray Air Stripper

Extracted groundwater is pumped through underground piping to the GWE&TS building where it is then conveyed to the top of a Carbonair Model STAT-180 low-profile stacked-tray air stripper, utilizing a 5-tray modular design. From the top of the stripper, the water flows by gravity through five trays in series before exiting the stripper. As the water flows down each tray, air is forced up through the water, thus stripping the volatile organic components out of the contaminated water. The air stripper was designed to reduce PCE in the extracted groundwater from a maximum inlet concentration of 1,200 ug/l to an effluent concentration of no greater than 1 ug/l, at a maximum flow rate of 70 gpm. Upon discharge from the air stripper, more than 99% of the volatile components are removed from the water. The vapor-phase exhaust from the air stripper is directed to the GWE&TS exhaust stack for discharge to the atmosphere.

Based on analysis of the effluent sample data from system start-up in September 2004, the low-profile stacked-tray air stripper is consistently removing PCE from extracted groundwater to concentrations below the laboratory MDL of 0.12 ug/l, and well below the site-specific effluent limit of 5 ug/l. In addition, the air stripper has been out-of-service for removal of accumulated iron and salt deposits on the trays on only one occasion in, which was completed as a preventative maintenance activity in February 2010.

In an effort to improve the efficiency of the air stripper while still maintaining adequate VOC removal requirements, the stripper manufacturer (Carbonair) was contacted and several new scenarios were modeled utilizing recent contaminant concentration and influent flow data. Based on this modeling, and as recommended in Section 4.0, it may be warranted to reduce the amount of trays utilized by the air stripper, while still attaining all site-specific effluent goals.

Pressure Blower

A New York Blower Model 2506 belt-driven blower with a 20 horsepower motor draws ambient air from outside the GWE&TS building, through the low-profile stacked-tray air stripper and then discharges to the atmosphere. The blower has operated since system start-up in September 2004 and has only been periodically taken out of service for routine maintenance.

The pressure blower was designed to operate at 650 cubic feet per minute (cfm), and has typically been operating at a range of approximately 600 cfm to 650 cfm since system start-up in September 2004. However, due to the reduction in static pressure within the vapor-phase effluent piping following the bypassing of the GAC vessels, the blower has been operating at an average of approximately 875 cfm from June through August 2011. In order to increase the efficiency of the blower following the bypassing of the GAC vessels and any future modifications to the air stripper design, it is warranted to reduce the blower flow rate to the design air flow rate of 650 cfm. Note that the pressure blower is currently operating at 100% capacity and the only means to reduce its airflow is by modulation of an integral outlet dampener. As such, it is warranted to reduce air flow generated by the pressure blower by a more efficient means, while still attaining all site-specific effluent goals. Recommendations for modification of the pressure blower controls are provided in Section 4.0.

Wet Well Submersible Pumps

Treated groundwater from the low-profile stacked-tray air stripper is discharged to a 6-foot diameter by 8-foot deep wet well equipped with two submersible pumps, which operate "one at a time," in a series cycle. The submersible pumps convey the treated water via underground piping to a NCDPW storm sewer manhole, in accordance with all applicable discharge standards. Persistent malfunctioning of the submersible pumps has caused the vast majority of the alarm/shutdown conditions since system start-up in September 2004. Further detail regarding the wet well submersible pump malfunctions and associated downtime is discussed in Section 3.0.

Vapor-Phase Granular Activated Carbon Vessels

Vapor-phase discharge from the air stripper was initially treated utilizing two vapor-phase GAC vessels, in a series configuration. However, based on low concentrations of VOCs in the vapor-phase discharge, and per the direction/approval of the NYSDEC, the GAC vessels were bypassed and the GWE&TS exhaust piping was modified so as to discharge directly to the atmosphere in June 2011. The vapor-phase discharge continues to be monitored for VOCs by PID on a weekly basis and by laboratory analysis via Method TO-15 on a semi-annual basis, in order to gauge the need to possibly reconnect the GAC units in the event sampling results warrant such. However, as the GAC vessels will remain in "stand-by" mode for the foreseeable future, no further evaluation of the vapor-phase GAC vessels is warranted at this time.

3.2.3 General Facility, Routine and Non-Routine System Maintenance

As presented in Section 2.0, general facility, routine and non-routine maintenance activities are completed at the Site as per the requirements of the October 2003 O&M Plan. An evaluation of these services is provided below:

General Facility Maintenance

General facility maintenance activities are completed at the Site on an as-needed basis. Based on the current condition of the GW&TS facility and Site property, the general facility maintenance requirements undertaken at the Site in accordance with the October 2003 O&M Plan are considered adequate.

Routine Maintenance

The routine maintenance activities completed at the Site involve scheduled inspection and maintenance of the GWE&TS equipment and appurtenances,ensuring that all GWE&TS components are maintained in accordance with the manufacturer's operations and maintenance manuals. Overall, the treatment system was non-operational for approximately 6 days (144 hours) since system start-up in September 2004 as a result of routine maintenance activities.

All routine maintenance is performed in accordance with the manufacturer's operations and maintenance manuals and all GWE&TS remedial components have generally operated reliably since system start-up in September 2004. Accordingly, the routine maintenance requirements detailed in the October 2003 O&M Plan is considered adequate.

Non-Routine Maintenance

Non-routine maintenance activities completed at the Site are those tasks which involve out of scope maintenance and upkeep of the GWE&TS components. Non-routine maintenance activities are conducted in response to GWE&TS alarm/ shutdown conditions and as a result of decreased component performance, such as a differential pressure above 45 inches of water in the low-profile air stripper. Significant non-routine maintenance events, associated system downtime and the current status and/or resolution associated with each activity are summarized on *Table 3-4*.

Since system start-up in September 2004, the GWE&TS was not operational for approximately 54 days (1,299 hours) as a result of non-routine maintenance activities. The majority of non-routine system downtime is associated with persistent malfunctions of the submersible pumps within the wet well and failures of the pumps within each extraction well. Further detail regarding these failures and associated downtime are discussed in Section 3.2.5.

In addition, note that the GWE&TS was originally equipped with paddle wheel-style flow meters to monitor influent flow rate and volumes. The influent flow meters have consistently malfunctioned over the course of the past several years, likely due to a relatively high iron content in the extracted groundwater. As such, the influent meters necessitated frequent cleaning, contributing to system downtime. In order to reduce downtime associated with the influent flow meters, the paddle wheel-style influent flow meters were replaced with "mag-style" flow meters on June 23, 2011.

3.2.4 System Alarm Conditions

The GWE&TS is equipped with an auto-dialer alarm notification system, which is programmed to call technicians in the event of an alarm condition. As described above, the GWE&TS was not operational for approximately 192 days (4,627 hours) since system start-up in September 2004 as a result of system alarms/shutdown conditions. The most significant and frequently occurring alarm conditions and their associated downtime throughout this reporting period are summarized on *Table 3-4*.

3.2.5 System Downtime

A general system downtime summary is provided below:

Table 3-5: System Runtime/Downtime Summary

Runtime - Current Monitoring Period (1)	2,141 hours	96.9%
Downtime - Current Monitoring Period (1)	68 hours	3.1%
Total Runtime to Date (2)	60,710 hours	89.7%
Total Downtime to Date	6,231 hours	10.3%

1. Total elapsed time for current monitoring period (June through August 2011) is 2,209 hours.

2. Based on a system start-up date of September 20, 2004.

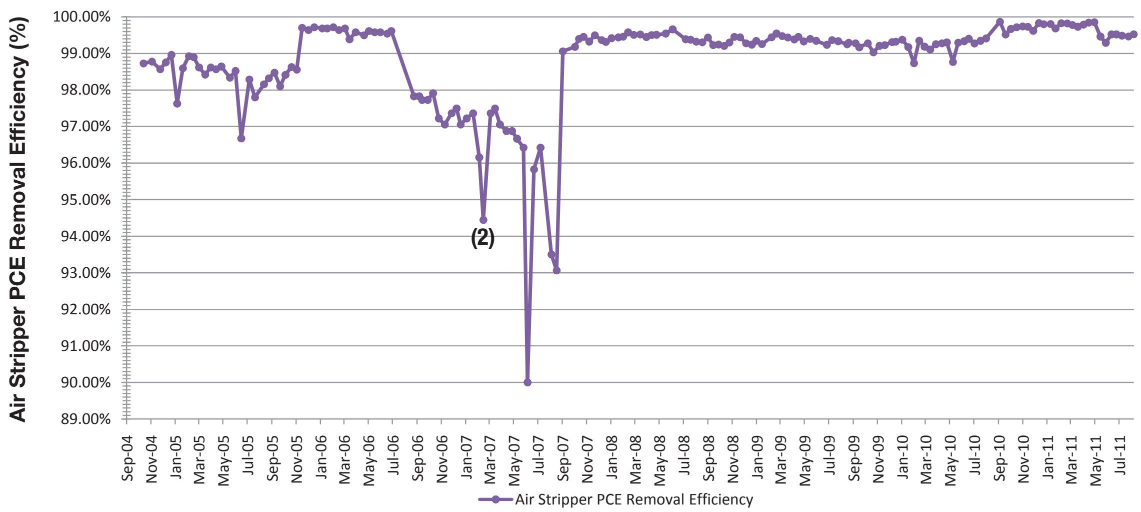
A brief summary of the most significant downtime items is provided below:

- Following several diagnostic attempts since system start-up, a persistent malfunction of the wet well submersible pumps was diagnosed as having been caused by a cracked phase loss detection device in the pump control panel, which was replaced in August 2010. Since the device was replaced, the wet well submersible pumps have operated efficiently and the GWE&TS has not experienced any further due to the wet well submersible pump malfunctions;
- Extraction well EW-1 was shut down on November 15, 2005 due to a variable frequency drive (VFD) overload failure, which was diagnosed to have been caused by a malfunctioning pump and motor. From November 2005 through March 2006, the NYSDEC coordinated with the New York State Department of Transportation (NYSDOT) to obtain the required permits needed in order to access EW-1 from the Southern State Parkway right-of-way. From March 2006 through June 2006, D&B coordinated with the NYSDEC to prepare a technical scope of work to complete the extraction well pump and motor replacement. During this time period, competitive quotes were also procured from several subcontractors to perform the work. D&B received authorization from the NYSDEC to proceed with the work in July 2006. On September 7, 2006, the extraction well pump and motor were removed and the extraction well was redeveloped. Following redevelopment, a new extraction well pump and motor were installed in the extraction well; and
- Extraction well EW-2 was shut down on July 25, 2006 due to a VFD overload failure, which was diagnosed to have been caused by a high amperage draw from the extraction well motor. On August 30, 2006, the extraction well pump and motor were removed and the extraction well was redeveloped. Following coordination with the NYSDEC and NYSDOT, a scope of work to complete the extraction well pump and motor replacement was approved in April 2007. Several quotes were received to complete the work and were submitted to the NYSDEC for approval on June 12, 2007. Based on NYSDEC request, a follow-up cost reasonableness evaluation was also submitted on June 25, 2007. D&B received authorization from the NYSDEC to proceed with the pump and motor replacement work on July 30, 2007. On August 30, 2007 the extraction well pump and motor were removed and a new extraction well pump and motor were installed in the extraction well.

3.2.6 Mass Removal Efficiency

A summary of the historical aqueous-phase mass removal efficiency for the GWE&TS is provided below:

Figure 3-15
Air Stripper PCE Removal Efficiency(1)



1. The approximate PCE removal efficiency for the low-profile stacked-tray air stripper ranged from 99.24% to 99.63% during current monitoring period (June through August 2011). Additionally, it should be noted that the average differential pressure across the low-profile air stripper was substantially less than 45 inches of water (manufacturer's recommended threshold for equipment maintenance) during this reporting period.

2. Note that, based on review of the extraction well flow and contaminant concentration trends and air stripper mass removal efficiency, the lower mass removal efficiencies coincide with time periods when extraction well EW-2 was not operational, suggesting that extraction well EW-1 may currently be extracting a relatively high component of "clean" groundwater.

3.2.7 Discharge Compliance

As described in Section 2.0, aqueous-phase and vapor-phase samples are collected from the GWE&TS on a routine basis to evaluate overall efficiency, while at the same time, ensuring that all GWE&TS discharges are below/within applicable standards and/or site-specific limits. The site-specific aqueous-phase effluent limits are provided in *Attachment B*. A site-specific effluent limit of 0.5 lbs/hr for PCE was developed in consultation with the NYSDEC and is utilized as a means to monitor total vapor-phase VOCs emitted by the GWE&TS.

Since system start-up in September 2004, concentrations of PCE in aqueous-phase effluent discharged from the low profile stacked-tray air stripper have ranged from nondetect to a maximum concentration of 1 ug/l, with an average concentration of 0.5 ug/l, well below the site-specific effluent limit of 5.0 ug/l.

As presented on *Table 3-6*, iron has been sporadically detected at concentrations in exceedance of its site-specific effluent limit of 1,000 ug/l, ranging in concentration from 1,080 ug/l to 2,890 ug/l. In addition, pH has been sporadically detected outside of its site-specific effluent range of 6.5 to 8.5 in routine field screening activities, ranging in value from 5.5 to 6.44. Note that, as per direction from the NYSDEC, the GWE&TS was not shut down as a result of these exceedances due to the fact that such incidences were generally intermittent.

However, in response to observing the pH in the effluent outside of the site-specific effluent value range in laboratory-analyzed samples, field monitoring of pH was added to the routine monitoring activities in October 2009, in order to better assess effluent pH and compare field pH readings to the pH results detected by the laboratory. In most instances the laboratory analytical results indicated a pH less than the site-specific effluent value range, while the field monitoring results indicated a pH within the site-specific effluent value range. This discrepancy may be due to the tendancy of pH values in water to fluctuate based on variations in temperature and carbon dioxide content, both of which can be affected by sample collection methologies and sample shipment. It is worthy to note that USEPA SW- 846 recommends analyzing pH immediately, as a means of improving the reliability of pH results. Due to continued discrepancies between field and laboratory analyzed pH results, the NYSDEC no longer requires laboratory analysis of pH at the Site.

Although, as described in Section 3.0, total VOCs in GAC vessel vapor-phase discharge have been detected at concentrations in exceedance of the maintenance threshold of 1.0 ppm, the site-specific effluent limit of 0.5 lbs/hr had not been exceeded during these or any other monitoring events.

3.2.8 Process Generated Waste

As stated in Section 2.0, vapor-phase discharge from the air stripper was initially treated utilizing two 1,000 lb capacity GAC vessels, configured in a series arrangement and with controls and valving to allow for either unit to act as the primary or secondary vessel. However, based on historical low contaminant concentrations detected in the air stripper exhaust gas, the air stripper exhaust piping was reconfigured to bypass the GAC vessels and discharge directly to the atmosphere in June 2011, per the direction of the NYSDEC.

The GAC vessels were designed to remove 99% of the PCE concentrations within the low-profile stacked-tray air stripper exhaust, from an aqueous-phase influent concentration of 1,200 ug/l PCE. As detailed in the December 2000 Design Report, based on these design characteristics, it was assumed that the GAC "loading rate" would be approximately 10 lbs per day, and change-out of the GAC within each primary vessel would be completed at approximately 100-day intervals. The GAC vessel vapor-phase influent and effluent was monitored utilizing a photoionization detector (PID) on a weekly basis. The PID monitoring was utilized as a means to monitor the effectiveness of the GAC vessels, with respect to maintenance and change-out requirements for the GAC within each vessel. The GAC maintenance threshold was 1.0 part per million (ppm). Note that this is not a site-specific effluent discharge limit; the site-specific effluent limit of 0.5 lbs/hr for PCE was developed in consultation with the NYSDEC and is utilized as a means to monitor total vapor-phase VOCs emitted by the GWE&TS.

PCE concentrations within extracted groundwater have been considerably below the design influent concentration of 1,200 ug/l since system start-up in September 2004. As such, the actual GAC "loading rate" was considerably less than 10 lbs per day and the GAC material within the GAC vessels has not been replaced since system start-up. However, VOCs in GAC vessel vapor-phase effluent have been detected at concentrations in exceedance of the maintenance threshold of 1.0 ppm sporadically in 2005 and 2006, and generally consistently through the majority of 2010, indicating that the GAC within each vessel had likely become exhausted and required replacement. Note that the site-specific effluent limit of 0.5 lbs/hr had not been exceeded during these or any other monitoring events.

3.3 Operation and Maintenance Costs

In order to provide the most relevant O&M cost analysis, the evaluation below includes an analysis of the most recently available cost information for a 1-year period of GWE&TS operation (December 2010 through November 2011), followed by a summary of the current and "to date" total VOC removal costs of the GWE&TS. Note that this evaluation includes engineering services costs, NYSDEC "call-out" contractor costs, analytical laboratory costs and Site utility costs (electric and telephone). It should be noted that this evaluation does not include NYSDEC labor and expense costs associated with project management. A summary of the O&M costs is provided on *Table 3-7*.

3.3.1 Engineering Services Costs

D&B's engineering services labor effort includes the preparation of Site Management Quarterly Reports, Periodic Reports, a Site Management Plan, subcontractor oversight, routine project management/client coordination and "out-of-scope" engineering services, as requested by the NYSDEC. Engineering services costs for December 2010 through November 2011 were approximately $150,463, and accounted for approximately 54% of the total O&M costs for the GWE&TS.

3.3.2 NYSDEC "Call-Out" Contractor Costs

The NYSDEC "call-out" contractor costs include both labor and materials necessary to complete all general facility maintenance, routine/non-routine maintenance, alarm response, sample collection and system monitoring. Note that these costs do not include laboratory analytical or Site utility costs, which are detailed below. The NYSDEC "call-out" contractor costs for December 2010 through November 2011 were approximately $91,990 and accounted for approximately 33% of the total O&M costs for the GWE&TS.

3.3.3 Site Utility Costs

Utilities for the GWE&TS include electric service for operation of the extraction well and wet well pumps, pressure blower, process instrumentation and Site lighting, and telephone service for the auto-dialer alarm notification system. Electric service costs for calendar year 2011 were approximately $25,983, and accounted for approximately 9.3% of the total O&M costs for the GWE&TS. Based on review of the electrical requirements of each system component, the majority of the electrical costs were incurred by operation of the pressure blower. Telephone service costs for December 2010 through November 2011 were approximately $572, and accounted for approximately 0.2% of the total O&M costs.

3.3.4 Analytical Laboratory Costs

Analytical laboratory costs resulting from the analysis of system process water and groundwater samples for December 2010 through November 2011 were approximately $9,859, and accounted for approximately 3.5% of the total O&M costs for the GWE&TS. Sample frequencies and analytical parameters are discussed in Section 2.0.

3.3.5 Costs Summary

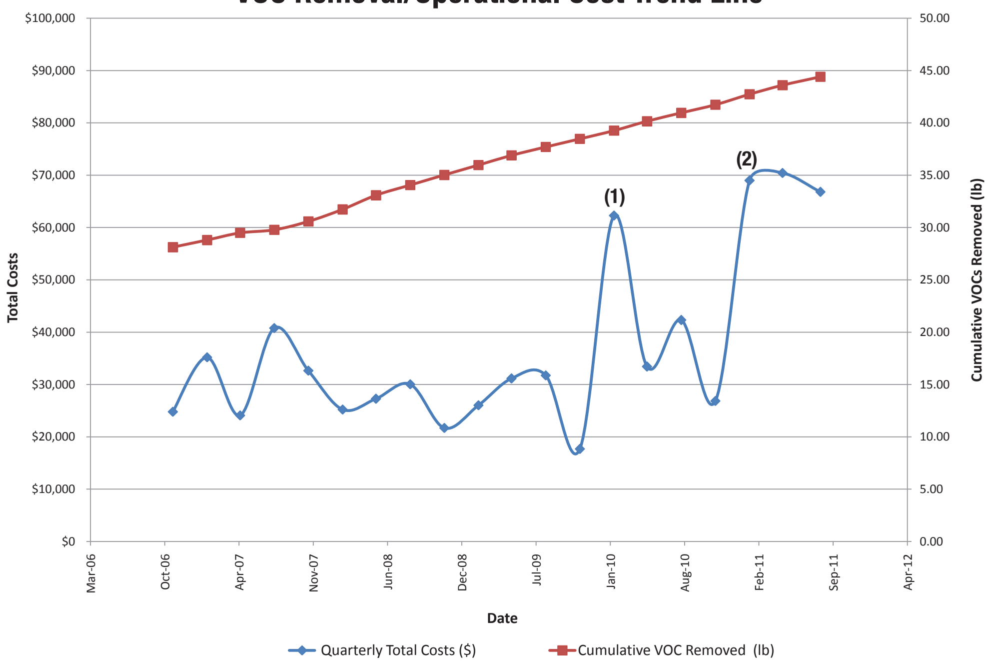
Based on the cost evaluation provided above, the total cost for operation and maintenance of the GW&TS for December 2010 through November 2011 was approximately $278,867, with an average monthly cost of $23,239. Provided below is an analysis of the operating costs per pounds of VOC removed:

Table 3-8: VOC Removal Costs (1)	
VOC Removal Cost - Current Monitoring Period	$77,671 per lb.
Average VOC Removal Cost to Date (2)	$33,811 per lb.

1. The VOC removal costs include monthly utility charges, maintenance costs and engineering costs. Capital construction costs and NYSDEC project management effort are not included in this evaluation.

2. Average calculated from system start-up in September 2004 through the most recent monitoring period.

Figure 3-16
VOC Removal/Operational Cost Trend Line



1. These costs reflect higher than typical NYSDEC "call-out" contractor costs due to completion of a preventative maintenance event for the air stripper, a repair of a roof leak, preventative maintenance of the containment island, maintenance and repairs of the pressure washer and repair/replacement of the influent flow meters.

2. These costs reflect higher then typical NYSDEC "call-out" contractor costs due to completion of several snow plowing events and reapplication of the epoxy floor coasting. In addition, note that higher then typical engineering services costs were due to the revision of the draft Franklin Cleaners Periodic Review Report (PRR).

3.4 Groundwater Monitoring Well Conditions

All seven groundwater monitoring wells were found to be accessible during the Site Inspection completed on October 18 and 19, 2010 as part of the Background Search and Site Inspection fieldwork. All groundwater monitoring wells were located as indicated on the Site map and the concrete well pads (where applicable), protective casings, surface seals, well IDs, PVC well risers, well plugs and locks were observed to be present and in good condition, with the exception of several damaged monitoring wells. The well damage summarized below was caused by the repaving of a parking area by Molloy College in the vicinity of the wells, as follows:

Monitoring Well ASMW-4

Monitoring Well ASMW-5

- All groundwater monitoring wells had visible well IDs, with the exceptions of groundwater monitoring wells ASMW-6 and ASMW-7;
- The well pad at groundwater monitoring well ASMW-4 has been destroyed and/or removed. In addition, the monitoring well cover was observed to be damaged and the cover bolts were stripped;
- The well cover at groundwater monitoring well ASMW-5 is currently below present surface grade. The well pad has been destroyed and/or removed and the locking well cap has been damaged. In addition, the well riser will need to be extended and resurveyed;

- The well pad and protective casing/manhole at groundwater monitoring well ASMW-6 was observed to have been demolished and/or removed. Soil had been excavated around ASMW-6 and a black drainage pipe was installed around the well riser by Molloy College during parking lot repaving and construction activities. The well riser is currently below grade. In addition, a concrete drainage ring, including a manhole cover, has been installed around ASMW-6; and
- A large PVC vault was observed to have been installed directly over groundwater monitoring well ASMW-7. A drainage ring structure was installed around ASMW-7 by Molloy College during parking lot repaving and construction activities. Several drainage pipes enter the drainage ring structure, where it is presumed that runoff from a portion of the newly paved area is discharged. In addition, the well riser will need to be extended and resurveyed.

3.5 Regulatory Compliance

Various aqueous-phase and vapor-phase process samples are collected from the GWE&TS in order to evaluate the overall efficiency of the GWE&TS and its various components, while at the same time, ensure that all GWE&TS discharges are below/within applicable standards and/or site-specific limits. The site-specific aqueous-phase effluent limits are provided in *Attachment B*. A site-specific effluent limit of 0.5 lbs/hr for PCE was developed in consultation with the NYSDEC and is utilized as a means to monitor total vapor-phase VOCs emitted by the GWE&TS.

All GWE&TS process and groundwater samples collected from system start-up in September 2004 through January 2010 were submitted to Mitkem Corporation (Mitkem) for analysis. All samples collected from February 2010 through the present were submitted to Test America Laboratories (TAL) for analysis. Both laboratories are New York State Department of Health (NYSDOH) Environmental Laboratory Approval Program (ELAP)-certified laboratories. The laboratory data packages are reviewed for completeness and compliance with NYSDEC Analytical Services Protocol (ASP) Quality Assurance/Quality Control (QA/QC) requirements. Any QA/QC issues arising with the sample results have been qualified as part of the routine Site Management Quarterly Monitoring Reports.

Based on review of the analytical data results from all completed groundwater monitoring well network sampling and based on the GWE&TS's compliance with all site-specific discharge limits for PCE, the GWE&TS is capturing and treating the groundwater plume as designed and has been in compliance with all PCE discharge regulations since system start-up. PCE has not been detected in any "sentinel" monitoring well or Rockville Centre production well located downgradient of the GWE&TS, with the exception of slight PCE detections in monitoring well ASMW-4, since system start-up. As described in Section 2.1.2, these slight detections are attributed to a change in analytical methods.

3.6 Achievement of Remedial Goals/Objectives

Analysis of contaminant trends within the extraction wells indicates that PCE concentrations have generally exhibited a steadily decreasing trend since system start-up in September 2004. However, concentrations of PCE have shown a slightly increasing trend in extraction well EW-1 since December 2009.

Since system start-up in September 2004, PCE concentrations in aqueous-phase effluent discharged from the low profile stacked-tray air stripper have consistently been detected well below the site-specific effluent limit of 5 ug/l. Although, total VOCs in GAC vessel vapor-phase effluent have been detected at concentrations in exceedance of the maintenance threshold of 1.0 ppm, total VOC concentrations have consistently been detected at concentrations well below the site-specific effluent limit of 0.5 lbs/hr.

Analysis of the contaminant trends within the monitoring wells indicates that PCE concentrations generally exhibited a steadily decreasing trend in monitoring wells located in close proximity to the leading edge of the groundwater plume since system start-up, with the exception of monitoring well ASMW-1.

Overall, the site-specific remedial goals and cleanup objectives established for the Site are generally being achieved. However, as PCE concentrations have consistently been detected in exceedance of the Class GA Standard within monitoring well ASMW-1, the groundwater plume may have shifted slightly to the west. Several system optimization and cost saving recommendations have been developed to expedite achievement of the remedial goals and objectives, as well as increase the efficiency, effectiveness and net environmental benefit of the GWE&TS, while at the same time, reducing overall project costs and expediting Site closure, as detailed below.

4.0 SYSTEM OPTIMIZATION/COST SAVING RECOMMENDATIONS

4.1 System Improvements and Modifications

Based on the findings presented in Section 3.0, several recommendations for system improvements and modifications have been developed to increase the efficiency, effectiveness and net environmental benefit of the GWE&TS, while at the same time, reducing overall project costs and expediting Site closure. The following narrative outlines recommendations for system improvements and modifications.

4.1.1 Major System Components

The major system components of the GWE&TS consist of the following:

- Extraction wells and pumps;
- Low-profile stacked-tray air stripper;
- Pressure blower;
- Wet well submersible pumps; and
- Vapor-phase granular activated carbon vessels.

The following recommendations form a multi-tiered approach to improving and modifying several key areas of each pertinent system component as appropriate, in order to increase the general efficiency and effectiveness of the overall GWE&TS:

Extraction Wells and Pumps

Extraction wells EW-1 and EW-2 have been operating at flow rates of approximately 34.7 gpm and 6.5 gpm, respectively. However, based on current PCE concentration trend analysis and pump test data summary provided in Section 3.0, EW-1 operating at a flow rate of approximately 30 gpm would create a “capture zone” sufficient to capture the entire leading edge of the groundwater plume, assuming the groundwater plume location has not changed significantly since system start-up. As such, and in order to increase the efficiency of the GWE&TS, D&B recommends EW-1’s flow rate be decreased to 30 gpm. The reduction in EW-1’s flow rate will provide two efficiency-related benefits, as detailed below:

- Higher Mass Removal Efficiency: Based on review of extraction well EW-1’s radius of influence and current contaminant concentrations detected in monitoring well ASMW-3, EW-1 is currently extracting a relatively high component of “clean” groundwater from the eastern portion of its radius of influence. A slight reduction in EW-1’s flow rate to 30 gpm will reduce the amount of “clean” groundwater entering the GWE&TS, therefore, increasing its mass removal efficiency; and
- Reduced Operating Cost: The reduction in EW-1’s flow rate will slightly reduce its electrical consumption and, therefore, provide for a small annual cost savings.

Note that this recommendation was implemented on February 29, 2012, during development of the RSO Report and although it is believed that the groundwater plume has shifted slightly to the west, the downgradient “sentinel” monitoring wells have remained non-detect for PCE.

Low-Profile Stacked-Tray Air Stripper

The low-profile stacked-tray air stripper was designed to reduce PCE concentrations in the extracted groundwater from a maximum influent concentration of 1,200 ug/l to an effluent concentration of no greater than 1 ug/l, at a maximum flow rate of 70 gpm. Upon discharge from the air stripper, more than 99.9% of the volatile components are removed from the water, utilizing a 5-tray modular design. As current groundwater influent flow rates and PCE concentrations are significantly lower than design specifications of the air stripper, the unit can be downsized and still maintain compliance with regard to the site-specific discharge limits and performance criteria, while operating in a more efficient manner. Since January 2010, extraction well EW-1 has pumped at an average flow rate of 32.6 gpm of groundwater containing a maximum concentration of 25 ug/l PCE, and extraction well EW-2 has pumped at an average flow rate of 6.31 gpm of groundwater containing a maximum concentration of 76 ug/l PCE.

Accordingly, the air stripper manufacturer (Carbonair) was contacted to assist in performing several new modeling scenarios utilizing the current contaminant concentrations and influent groundwater flow data. Utilizing a reduced design air flow rate of 650 cfm (rather that the current 875 cfm) this modeling effort determined that the existing air stripper can achieve approximately 99.9% PCE removal while operating with only three of the five modular stripping trays. Therefore, D&B recommends two modular trays be removed from the air stripper.

Note that, reducing the amount of modular stripper trays utilized by the air stripper will effectively reduce the static pressure within the vapor-phase effluent piping, which will impact the pressure blower's operation. These impacts and associated costs savings are discussed below.

Pressure Blower

The pressure blower was designed to operate at 650 cubic feet per minute (cfm), and has typically been operating at a range of approximately 600 cfm to 650 cfm since system start-up in September 2004. However, due to the reduction in static pressure in the vapor-phase effluent piping following the bypassing of the GAC vessels in June 2011, the blower has been operating at an average of approximately 875 cfm from June through the present. In addition and as detailed above, reducing the amount of modular trays utilized by the air stripper will further reduce the static pressure within the vapor-phase effluent piping. Based on the static pressure reduction resulting from these system modifications, the following recommendations are provided to increase the efficiency of the pressure blower:

- Variable Frequency Drive: The pressure blower is currently equipped with an integral outlet dampener as the only means to modulate its air flow rate. In order to reduce the pressure blower air flow rate in a more efficient manner, D&B recommends installing a variable frequency drive (VFD) to electronically control the pressure blower motor output, and therefore its air flow rate to provide for a means to reduce its electrical consumption; and
- Reduction in Air Flow Rate: In order to increase the efficiency of the pressure blower following installation of the VFD and modification of the low-profile stacked-tray air stripper, D&B recommends the pressure blower's output be modulated via the VFD to achieve the design airflow rate of 650 cfm. Based on the pressure blower manufacturer's specifications, D&B calculates that the pressure blower will consume approximately half of the electricity it currently consumes following these system modifications. Even accounting for the additional electricity consumed by the addition of the VFD, D&B estimates that the proposed modifications to the pressure blower (following the modification to the air stripper proposed above) will reduce the blower's electrical consumption by approximately 50% and provide for a projected annual cost savings of approximately $4,000, based on current electrical consumption and pricing.

Wet Well Submersible Pumps

Following replacement of the malfunctioning phase loss detection device in the pump control panel in August 2010, the wet well submersible pumps have operated efficiently and the GWE&TS has not experienced any further downtime due to wet well submersible pump malfunctions. As such, no further modifications are recommended regarding the wet well submersible pumps at this time.

However, based on the inconsistencies noted regarding the influent and effluent flow volumes, it is recommended to inspect the effluent flow meter to ensure it is functioning properly.

Vapor-Phase Granular Activated Carbon Vessels

As detailed above, exhaust gas from the air stripper was initially treated utilizing two vapor-phase GAC vessels, in a series configuration. However, based on low concentrations of VOCs in the vapor-phase effluent, and based on direction from NYSDEC, the GAC vessels were bypassed and the GWE&TS exhaust piping was modified to discharge directly to the atmosphere in June 2011. GWE&TS vapor-phase effluent gas continues to be monitored for VOCs by PID on a weekly basis and by laboratory analysis via Method TO-15 on a semi-annual basis. As the GAC vessels will remain in "stand-by" mode for the foreseeable future, no further modifications are recommended regarding the vapor-phase GAC vessels at this time.

4.1.2 Operation and Maintenance

In general, and as several persistent system malfunctions, such as the malfunctioning wet well submersible pumps and influent flow meters, have already been rectified, the operation and maintenance activities performed at the Site are considered adequate. However, the following recommendations regarding repair and improvement of the extraction wells and monitoring well network are provided in order to increase the general efficiency and effectiveness of the overall GWE&TS:

- Extraction Well Preventative Maintenance: In order to eliminate the high costs of conventional extraction well rehabilitation activities and increase the efficiency and effectiveness of the GWE&TS, D&B recommends implementation of a preventative maintenance program for extraction wells EW-1 and EW-2, such as the Aqua Gard™ system, to facilitate periodic treatment of the extraction wells in order to prevent future fouling and decreased well performance. It should be noted that installation of a permanent treatment provision, such as the Aqua Gard™ system, within each extraction well may minimize costs associated with any required future maintenance events, such as well redevelopment and extraction well pump change-out due to any future pump failures; and
- Monitoring Well Improvements: Based on the observed damage at monitoring wells ASMW-4, through ASMW-7, D&B recommends restoring these wells so they may be adequately accessed and protected, as follows:
    - ASMW-4: D&B recommends that the well pad at ASMW-4 be restored and brought up to present grade and that the monitoring well cover be replaced;
    - ASMW-5: D&B recommends that the well pad at ASMW-5 be restored and brought up to present grade and that the monitoring well cover be replaced. In addition, D&B recommends that the well riser pipe be extended and resurveyed;
    - ASMW-6: D&B recommends that the well pad at ASMW-6 be restored and brought up to present grade and that the monitoring well cover be replaced. In addition, D&B recommends that the vault and drainage structures positioned over/around the well by Molloy College be removed and the well riser pipe be extended and resurveyed;
    - ASMW-7: D&B recommends that the well pad at ASMW-7 be restored and brought up to present grade and that the monitoring well cover be replaced. In addition, D&B recommends that the vault structures positioned over the well by Molloy College be removed and the well riser pipe be extended and resurveyed. D&B further recommends the NYSDEC coordinate with Molloy College to remove the drainage structure and discharge piping observed in the immediate vicinity of ASMW-7, and to ensure that stormwater runoff is not discharged in the immediate vicinity of this or any other monitoring wells in the future.

In addition, based on the damage noted at monitoring wells ASMW-4 through ASMW-7 D&B recommends that the total depths of each monitoring well be evaluated in order to ensure debris has not entered these wells. Based on the results of this evaluation, it may be warranted to re-develop or re-condition some or all of these monitoring wells.

4.1.3 Monitoring and Sampling Program

The flowing monitoring and sampling program-related recommendations have been developed in order to increase the overall efficiency and effectiveness of the GWE&TS:

- SPDES Permit Equivalency Renewal: Since the current SPDES permit equivalency expired on January 31, 2006, D&B recommends that the Division of Environmental Remediation coordinate with the Division of Water to ensure the permit equivalency is renewed;
- Reduction of Monitoring Frequency: The overall system performance has been generally stable since system start-up in September 2004. An analysis of the weekly monitoring records shows that the operating parameters (i.e., extraction well flow rates, blower flow rate, operating pressures, etc.) are generally consistent and exhibit little variation between each weekly monitoring event. Therefore, in order to increase the GWE&TS's efficiency by reducing the overall system monitoring costs, D&B recommends a reduction in routine system monitoring events from a weekly to a bi-weekly frequency. This reduction in routine system monitoring events will result in a savings of approximately 50% in labor and expense costs associated with routine system monitoring; and
- Reduction of Sampling Frequency: Aqueous-phase influent and effluent PCE concentrations have been relatively stable over the course of the last two years of system operation. In order to increase the overall efficiency of the GWE&TS, D&B recommends reducing the routine system sampling from a bi-weekly to a monthly frequency. This reduction in monitoring will result in a savings of approximately 50% of the labor costs, analytical and expense costs associated with the system sampling.

In addition, a reduction in monitoring and sampling frequencies will provide for an overall reduction of environmental impacts associated with travel to and from the Site, the disposal of PPE, laboratory analytical costs, packaging materials utilized during sample shipment and overnight shipment of samples to the laboratory.

4.1.4 Routine/Non-Routine Maintenance

All routine maintenance is performed in accordance with the manufacturer's operations and maintenance manuals. Since the GWE&TS remedial components have generally operated reliably following several repairs described above, modifications to the routine/non-routine maintenance schedule are not recommended at this time.

4.1.5 GWE&TS Building

In order to reduce the electric usage associated with site lighting, D&B recommends investigating the feasibility of installing motion sensors on the existing building exterior lights. Adding motion sensor lighting would reduce Site electrical costs, while at the same time increasing Site security. In addition, it is recommended that all light bulbs within the GWE&TS building lighting fixtures be replaced with high efficiency bulbs to further reduce electrical costs.

As all general facility maintenance is generally performed in accordance with the October 2003 O&M Plan and the GWE&TS building is in good condition, no additional GWE&TS improvements or modifications are recommended at this time.

4.2 Renewable Energy

Installation of a geothermal heat pump system in the GWE&TS building was evaluated in order to increase the efficiency and net environmental benefit of the GWE&TS. Geothermal heat pump systems use a fraction of the electricity of a typical electric-powered heating system, which is currently in-place at the Site. As such, the installation of a geothermal heat pump system in the GWE&TS building could provide a renewable energy source at the Site and decrease building heating costs in the winter months. In addition, since groundwater extraction wells and influent piping already exist at the Site, installation costs incurred by the NYSDEC would be minimized.

Following a Site meeting and several discussions with a geothermal heat pump installation contractor, it was determined that installation of an appropriately sized geothermal heat pump system at the Site would cost approximately $11,000. In addition, the geothermal heat pump system would cost approximately $160 per month in electrical costs to operate during the heating season, based on current electrical pricing. Based on review of annual electricity bills, electrically heating the GWE&TS costs an average of approximately $400 per month during the heating season (January, February, March, October, November and December).

Based on the geothermal heat pump installation and operational costs provided above, the “return-on-investment” time frame would be approximately eight years. As such, and as generally declining contaminant concentrations may not warrant the continued operation of the GWE&TS for eight additional years, a geothermal heat pump system installation may not be cost-effective at this time.

In addition, based on the similarly high installation costs and relatively high “return-on-investment” time frames of other renewable energy technologies, such as solar and wind power, implementation of these technologies is not considered cost-effective for this Site at this time.

4.3 Supplemental Investigations/Studies

Based on the results of the pump test completed in November and December 2011, monitoring well ASMW-1 is located within the “capture zone” of the extraction wells. Current PCE concentrations within ASMW-1 have remained elevated and have exhibited a slightly increasing trend since August 2009, indicating that the groundwater plume may be shifting slightly to the west. As such, D&B recommends installing several temporary vertical profile well locations along the length and leading edge of the groundwater plume in order to delineate the groundwater plume’s current vertical and horizontal extent. In addition, several temporary vertical profile well locations are recommended to be installed in upgradient and side-gradient areas of the groundwater plume, in order to investigate the potential for upgradient and/or side-gradient contaminant sources unrelated to the Franklin Cleaners Site.

Based on the results of the samples collected from the temporary vertical profile wells, it may be warranted to install additional permanent groundwater monitoring wells in association with the leading edge of the plume to be included as part of long term groundwater monitoring at the Site. In addition, we recommend that several soil borings be advanced to depths of at least 120 feet below grade in order to investigate the competency of the clayey soil unit referenced in the December 2000 Design Report as “confining the groundwater plume.” Upon approval of this recommendation, D&B will provide the NYSDEC with a temporary vertical profile well installation and sampling scope of work for review and approval.

4.4 Alternative Technologies

The use of alternate technologies in place of or in conjunction with the GWE&TS, may lower the overall cost of the remedy and expedite Site closure. As future PCE concentrations reach asymptotic levels within the extraction wells and monitoring well network at the Site, alternative remedial technologies such as chemical injection and/or monitored natural attenuation (MNA) may possibly be utilized at the Site in the future.

These alternative technologies are briefly described below:

- Chemical Injection: In-situ chemical injection is the injection of chemical oxidants into targeted zones the subsurface that are intended to directly break down contaminants into more stable, less mobile and/or less toxic non-hazardous compounds such as water, carbon dioxide and chloride via chemical reaction. As the site-specific contaminant is PCE, a chlorinated solvent, in-situ injection of ozone, potassium permanganate or sodium permanganate may be a viable and more cost-effective alternative to the continued operation of the GWE&TS in the future. However, any future chemical injection activities should be completed well upgradient of the GWE&TS extraction wells and Rockville Centre public supply wells in order to prevent these chemicals from adversely impacting these facilities. The feasibility of a chemical injection program would be further evaluated based on the results of the additional groundwater plume delineation program discussed above. In addition, prior to a full scale implementation of an in-situ chemical injection program, D&B recommends the completion of a pilot scale study to gauge the groundwater plume's response to such injections. Upon approval of this recommendation and once Site conditions warrant such, D&B will provide the NYSDEC with a chemical injection program scope of work for review and approval; and

- Monitored Natural Attenuation: Following completion of any chemical injection programs and/or once asymptotic or near-asymptotic concentrations of PCE are observed within the extraction wells and monitoring well network at the Site, MNA may be considered in conjunction with a phased shut-down of the GWE&TS. If MNA is selected to be utilized at the Site, D&B recommends that the routine groundwater monitoring program be continued throughout the phased shut-down and MNA processes, in order to monitor for PCE concentration "rebound" conditions and PCE trends over time. In addition, certain breakdown products associated with the attenuation of PCE, such as vinyl chloride (VC), are more mobile and toxic that PCE. As such, PCE breakdown components, such as VC, should be closely monitored during the MNA program. Upon approval of this recommendation and once Site conditions warrant such, D&B will provide the NYSDEC with a MNA program scope of work for review and approval.

It is important to not that the slightly increasing PCE concentrations detected in extraction well EW-1 since 2009 along with the presence of the Rockville Centre public water supply wells downgradient of the Site, must be considered while evaluating the implementation of these alternative technologies in the future.

4.5 Site-Specific Exit Strategy

Site-specific "exit strategies" are developed in order to ensure that the established remedial goals and cleanup objectives, as determined for the Site by the NYSDEC and as presented in Section 2.4, are achieved. Pursuant to Site closure, this RSO has been developed to expedite attainment of the remedial goals and cleanup objectives in the most efficient and effective manner possible.

As presented above, further groundwater plume delineation is warranted based on the current PCE concentrations detected in ASMW-1, which have remained elevated and have exhibited a slightly increasing trend since August 2009, indicating that the groundwater plume may be shifting slightly to the west. Once this additional plume delineation is completed, and following sustained asymptotic or near-asymptotic concentrations of PCE within extraction wells EW-1 and EW-2, implementation of the alternate remedial technologies and a phased system shut-down of the GWE&TS will be considered. However, since the Rockville Centre public water supply wells are located immediately downgradient of the Site, a phased system shut-down and utilization of such alternative technologies may not be possible unless the required SGCs are attained.

A general site-specific exit strategy sequence of events is provided below:

- Continue operation of the GWE&TS.
- Complete an additional groundwater plume delineation program. Based on the results of the additional groundwater plume delineation program, additional monitoring wells may be installed along the leading edge of the groundwater plume and the placement of the extraction wells will be evaluated for possible relocation.
- Once asymptotic or near-asymptotic contamination concentrations are observed within the extraction wells and groundwater monitoring well network, the implementation of alternative remedial technologies such as chemical injection and/or MNA would be evaluated. In addition, a phased shutdown of the GWE&TS would be initiated at this time, along with continued monitoring of the groundwater monitoring well network in order to monitor for PCE concentration "rebound" conditions over time.
- Following implementation of any selected alternative remedial technologies and the phased shutdown of the GWE&TS, a long-term groundwater monitoring program would be implemented in order to continue monitoring for PCE concentration "rebound" conditions over time.

In addition, since Site "source area" contamination has been successfully remediated via the SVE/AS system, the NYSDEC should consider reclassifying the Site pursuant to the requirements identified in 6 NYCRR §375-2.7 as a Class 4 Site as the "source area" contamination no longer appears to constitute a significant threat to public health or the environment. In doing so, however, D&B suggests the NYSDEC also consider implementing a post-remedial indoor air study within the "source area" structures and buildings to verify current Site conditions, in support of this proposed Site reclassification. Site delisting is not feasible at this time, as all remediation and post-remediation activities have not been completed.